HF fueling fears Jim Morris Hanby CPI stores 2 24 11 quotes RMP info OCA USW report 10pp

Use of toxic acid puts millions at risk

How we did this story

A worst-case scenario for each refinery is filed by its owner with the U.S. Environmental Protection Agency. Specifically, companies include what's known as an "Offsite Consequences Analysis," part of a larger plan that details how they manage myriad risks involved in manufacturing usable fuel from crude oil.

The EPA keeps close tabs on the documents and who views them because of the vulnerabilities of refineries, chemical plants and other facilities to accidents or acts of terrorism, and the potential for harm to millions of people living nearby. Particularly since the terrorist attacks of 2001, the government has spread a veil over such sensitive information – a veil that makes it difficult for members of the public to learn about risks in their midst.

A citizen can view Offsite Consequences Analyses only by visiting an EPA "reading room." They cannot be photocopied. They cannot be obtained on the Internet or from libraries.

After identifying 50 refineries that use hydrofluoric acid, five reporters from the Center for Public Integrity visited EPA headquarters in October 2010, scrutinized the relevant reports, and recorded the information in a spreadsheet. The reporters then contacted each company, giving it an extended opportunity to dispute or urge corrections to the reports. None of those who responded challenged the data.

On several occasions while filming outside refineries, journalists with the Center and ABC News were confronted and questioned by law enforcement authorities or refinery security personnel.

Download the full spreadsheet.

Interactive: Communities at risk

Do you live near an oil refinery? Check our interactive map below to see if your community may be at risk in the event of an accidental release of HF.

Exposing the hidden dangers that place oil refinery workers and nearby residents at risk.

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It was a disturbingly close call, closer than it appeared at the time. On July 19, 2009, an explosion rocked an oil refinery in Corpus Christi, Texas, critically injuring a worker and spawning a fire that burned for more than two days. The blast at the Citgo East refinery unleashed a chemical unknown to many Americans, though it is capable of sweeping into dozens of communities, sickening or even killing as it moves.

Hydrofluoric acid, known for its ability to race long distances in a cloud, is extremely toxic. It causes lung congestion, inflammation and severe burns of the skin and digestive tract. It attacks the eyes and bones. Experiments in 1986 detected the acid at potentially deadly levels almost two miles from the point of release.

Despite decades-old warnings that the compound, commonly called HF, could cause mass casualties — and despite the availability of a safer alternative — 50 of the nation's 148 refineries continue to rely on it.

At least 16 million Americans, many of them unaware of the threat, live in the potential path of HF if it were to be released in an accident or a terrorist attack, a joint investigation by the Center for Public Integrity and ABC News has found. The government maintains closely controlled reports outlining worst-case scenarios involving highly hazardous chemicals. The Center reviewed reports for the 50 refineries

that use HF. The reports describe the most extreme accidents anticipated by the plants' owners. The information is not published and is not easily accessible by the public.

A recent spate of refinery equipment breakdowns, fires and safety violations has heightened concerns. Over the past five years, authorities have cited 32 of the 50 refineries using HF for willful, serious or repeat violations of rules designed to prevent fires, explosions and chemical releases, according to U.S. Occupational Safety and Health Administration data analyzed by the Center. These "process safety management" standards require companies to conduct inspections, analyze hazards and plan for emergencies.

In all, at those 32 refineries inspectors found more than 1,000 violations, including nearly 600 at the BP refinery in Texas City, Texas, where 15 workers were killed and 180 injured in a 2005 explosion. Although only some of the violations involved HF, they can be an indicator of operational weaknesses, particularly worrisome at refineries using the chemical, industry and government insiders say. Even a fire causing little damage can foreshadow a more serious event, the American Petroleum Institute, the oil industry's main trade association, notes in a 2010 guidance document for its member companies.

Some worst-case scenarios described in company filings with the U.S. Environmental Protection Agency are particularly chilling: An HF release from the BP refinery in Texas City, for example, could total 800,000 pounds, travel 25 miles and put 550,000 people at risk of serious injury, according to BP's own calculations, provided to the EPA.

And a release from the Marathon refinery near Minneapolis could total 110,000 pounds, travel 25 miles and threaten 2.2 million people.

Refineries with HF also are located in or near cities including Los Angeles, Chicago and Philadelphia, as well as in rural parts of Oklahoma, Wyoming, Kentucky, and other states.

So closely guarded are details of the risks that even when HF leaves a refinery, its neighbors aren't always aware of the peril. Nor are government officials. After the 2009 release in Corpus Christi, Citgo told state regulators that only 30 pounds of the acid escaped plant boundaries. The U.S. Chemical Safety Board later estimated, however, that at least 4,000 pounds left the refinery and concluded that failures in a Citgo water system meant to contain HF had nearly led to a bigger release.

And when the safety board sought to make public a Citgo video of the fire, the company resisted, arguing that it would "raise substantial issues of national security." With the Department of Homeland Security's blessing, the board eventually posted the video on its website, along with a report listing a series of failures that could have proven disastrous.

When warning sirens sound at refineries, neighbors worry. "You never know, when you go to bed, if you're going to live through the night," said Janie Mumphord, who lives near Citgo.

The refining industry plays down the risks of HF, saying it has adequate safeguards in place and the chances of a catastrophic accident at any one location are slim. "There hasn't been any HF release that has impacted the communities," said Charles Drevna, president of theNational Petrochemical & Refiners Association. "We've controlled them."

The industry should take the threat more seriously, said Paul Orum, a chemical safety consultant who works with public-interest groups. "These are low-probability, high-consequence events, which is why

any individual company is not, by itself, motivated to make potentially expensive changes to a safer technology," Orum said. Still, the BP oil spill in the Gulf of Mexico last year "showed us that worst-case releases actually do happen."

Refiners use HF as a catalyst to make high-octane gasoline. A few companies, under pressure from advocacy groups and regulators, have switched to a modified form of the acid, which still poses significant risks to workers and communities but is less likely to travel as far. No refinery owner has embraced a product known as solid acid catalyst, which union officials and chemical safety experts say is far safer than HF.

The industry says that making a switch would prove too complicated and expensive. The cost of shifting from HF to alternatives is somewhere between $50 million and $150 million per refinery.

Drevna, of the petrochemical and refiners association, said there's no need for a change.

"We believe that there is a very useful purpose for hydrofluoric acid, that we have used it for 70 years-plus, [and] that we built redundant systems in to try to make sure that any mishap is contained," he said. Modifying refineries to use solid acid catalyst, he added, is "not a simple conversion."

Kim Nibarger, a health and safety specialist with the United Steelworkersunion, which represents 30,000 refinery workers, said such a conversion would be well worth it. "Fifty million dollars is pretty cheap insurance," he said. The union has called for a phase-out of HF.

Refinery mishaps, even when they don't involve HF, can be costly. BP has paid $137 million in federal fines and at least $2 billion to settle lawsuits arising from the 2005 accident in Texas City. The explosion was a consequence of cost-cutting by BP, according to OSHA and the Chemical Safety Board, which investigates accidents and suggests ways to prevent their recurrence. Had the blast involved an HF release, the human and economic toll could have been much higher.

The government's authority over industry is limited. The EPA does require companies using significant amounts of dangerous chemicals to manage them, disclose possible hazards and prepare for emergencies. Beyond that, however, the agency has little say over what chemicals companies use. Regulators can't compel a company even to consider alternatives to substances like HF.

While the Center has found no evidence that neighbors of U.S. refineries have died of HF exposure, several worker deaths have been documented in the medical literature.

Fast-moving cloud

The first hard evidence of the perils of an HF release from a refinery emerged in the summer of 1986. Amoco, which used the acid at its Texas City refinery (later acquired by BP), wanted to learn what would happen if large quantities got out. State regulators had expressed concerns, and Amoco approached Lawrence Livermore National Laboratory in California to conduct some tests.

The experiments took place at the Nevada Test Site, the epicenter of nuclear bomb testing during the Cold War. The assumption at the time was that any HF released from a vessel would stay in liquid form and could be captured on site before it did serious harm.

The Nevada tests showed otherwise.

Safely ensconced in a building about a mile away, Livermore physicist Ronald Koopman and his colleagues opened computer-controlled valves on a tanker truck loaded with 5,000 gallons of HF. The team released one-fifth of the HF at a temperature and pressure comparable to what would be found in a refinery.

What happened next stunned them. Video of that first test shows a white cloud moving quickly along the desert floor.

"None of the HF was collected as a liquid," said Koopman, an independent safety consultant who works both for environmental groups and industry. "It all went downwind. That was a surprise."

The conclusion: "Everything that's released in an accident under conditions similar to those in a refinery goes downwind as an aerosol and a vapor." Amoco's safety director, on the scene, was "just beside himself with concern," Koopman said. "He couldn't believe it."

Sensors detected potentially lethal concentrations of HF nearly two miles downwind of the tanker truck. Levels of the chemical were measured well above 30 parts per million, which the National Institute for Occupational Safety and Health considers "immediately dangerous to life or health."

The tests revealed another unpleasant surprise: It took a lot of water — much more than industry experts had imagined — to keep dangerous levels of HF from traveling beyond the plant fence. They had assumed that 20 parts of water applied in a spray to one part of HF would do the job, but this wasn't the case. A second round of tests in Nevada in 1988 showed that twice as much water was needed to remove 95 percent of the acid from the air, assuming the system worked exactly as planned, Koopman said.

Amoco insisted that the video of the Nevada experiments include a disclaimer stating that an HF release as massive and fast-moving as the one seen in the first test was unlikely.

Koopman, however, maintained that such a release — while admittedly a worst case — is "not an impossible case. It's not an unrealistic case. It could happen. If people were in that cloud … they would die, I think unquestionably. Unless they could hold their breath until it passed."

The EPA reiterated the risks of HF in a 1993 report to Congress mandated by the 1990 Clean Air Act amendments. The agency found that HF in "dense vapor and aerosol clouds could pose a significant threat to the public, especially in those instances where HF is handled at facilities located in densely populated areas."

Legislation that would have forced companies to weigh alternatives to hazardous chemicals such as HF has failed repeatedly amid industry resistance. In a 2009 letter to House leaders, a group of trade organizations, including the American Petroleum Institute and the National Petrochemical & Refiners Association, said that such a mandate would be "unnecessary and potentially very disruptive."

But Patty Murray, who chairs a U.S. Senate subcommittee on employment and workplace safety, said the refining industry should convert from HF to something safer. "The cost is so small compared to the billions of dollars in profits that these companies make," Murray told the Center. The Washington Democrat has an HF refinery in her home state: The ConocoPhillips refinery in Ferndale, near the Canadian border and the outskirts of Canada's most populous western city, Vancouver. Some 170,000 people within a 14-mile radius are at risk, according to the company's worst-case scenario.

As far back as 1975, Rick Engler, then with the Philadelphia Area Project on Occupational Safety and Health, a coalition of unions and health and safety professionals, cited insurance data showing that financial losses from accidents involving HF had increased "in both magnitude and number." Nonetheless, Engler wrote in a report, HF had surpassed a rival, somewhat safer catalyst — sulfuric acid — in popularity because "HF units have lower installation and operating costs."

The scales had tilted in favor of HF.

"Clearly, the industry felt it was more profitable to use the more dangerous process, and that's what they decided to do," said Engler, now director of the New Jersey Work Environment Council, an alliance of labor, environmental and community organizations.

By the mid-1970s, the industry had made commitments to refinery design that couldn't easily be altered. The breakdown today: Fifty refineries with alkylation units — which produce high-octane components of gasoline — use HF as a catalyst. Another 50 or so use sulfuric acid. About 50 more lack alkylation units and, therefore, use neither.

In a 2009 paper, the National Petrochemical & Refiners Association noted that eliminating HF would force a refinery to "completely replace its alkylation unit at a cost of $45 million to $150 million," maybe more.

'It was luck'

The most serious HF-related accident in the U.S. occurred on October 30, 1987, at Marathon Petroleum Company's Texas City refinery. As a crane moved a piece of equipment weighing several tons, the equipment came loose and fell on a vessel containing HF.

Over the next 44 hours, tens of thousands of pounds of the acid gushed out, drifting into nearby residential areas and forcing the evacuation of 4,000 people. More than 1,000 people went to the hospital with skin, eye, nose, throat and lung irritation.

Koopman, an expert witness for plaintiffs in litigation stemming from the accident, said it could have been much worse.

"The only reason that many people weren't killed was that the release shot a jet of HF straight up in the air" rather than sideways, he said. "We estimated the jet was about 200 feet high. Then it turned over and went to earth, about 1,200 feet downwind. There were people living right at the fence line, and they would have been exposed to lethal concentrations [had the HF cloud gone straight to the ground]. It was luck."

Just days before the accident, industry officials had assured Koopman at a conference that "it was not feasible for HF to be released, and that they never lifted heavy objects over HF tanks," he said. "It was quite ironic."

There were at least three accidents involving HF releases in 2009 — at the Sunoco refinery in Philadelphia, the ExxonMobil refinery near Joliet, Illinois, and the Citgo East refinery in Corpus Christi. After investigations, OSHA alleged a total of 25 safety violations against the companies. The Sunoco accident sent 13 workers to the hospital. The ExxonMobil accident prompted an air pollution lawsuit by the Illinois attorney general.

The Citgo accident came closest to becoming a full-scale catastrophe.

The flash fire in the Citgo HF alkylation unit, captured on a security camera, severely injured worker Gabriel Alvarado and kept on burning. Within a half-day, the water supply Citgo used for firefighting was nearly tapped out, Chemical Safety Board investigators determined. The company began pumping salt water from the Corpus Christi Ship Channel to the refinery's water storage area.

Although the makeshift system contained up to 90 percent of the HF gas that spewed from the damaged unit, there were "multiple failures" along the way and at least two tons of HF escaped, the safety board found. It also found that Citgo had never conducted a safety audit of the alkylation unit — an audit that the American Petroleum Institute, which sets voluntary standards for the industry, says should be done every three years.

OSHA cited Citgo for 18 violations, two of which were classified as willful, and proposed $236,500 in fines as a result of the accident. OSHA defines a willful violation as one that involves "either an intentional violation of the [Occupational Safety and Health] Act or plain indifference to its requirements." In Citgo's case, the agency alleged that the company hadn't repaired deficient equipment or updated operating procedures in the alkylation unit.

Citgo, which is contesting the citation, declined to comment for this story.

Suzie Canales, executive director of Citizens for Environmental Justice in Corpus Christi, said the HF incident followed a familiar pattern she has noticed after chemical accidents. Citgo insisted that the toxic cloud stopped at the plant fence. "That's what they always say," Canales said.

Some who lived near the refinery complained of headaches, nausea and respiratory problems, Canales said. Many didn't know what was going on as the event unfolded.

"I could see the flame and the smoke," said Al Bradley, who lives in the Hillcrest neighborhood, just east of Citgo. "The flame blacked out the complete north sky. I didn't know what to think. I tried to call the refinery, listened [to] the TV, radio — nothing. I wasn't certain what happened."

In a news release in December 2009, Citgo said that its estimate of the amount of HF that escaped was based on thousands of air monitoring samples taken by the company and the EPA. When it objected to the Chemical Safety Board's posting of the accident video, Citgo said, it was "simply acting in good faith to maintain and preserve the security of our refinery."

Earlier mishaps at the refinery had presaged the 2009 debacle.

In May 1996, OSHA records show, seven workers were hospitalized after being caught in an HF release estimated at 100 pounds. A year later, an explosion in the refinery's alkylation unit led to a release of unspecified size. In that case, the Sierra Club and other environmental groups alleged that there were "significant" HF exposures in nearby neighborhoods.

Citgo paid a $4,250 OSHA fine for the 1996 incident and $11,100 for the 1997 incident — small amounts, given the value of its products and the risks to people and property nearby.

All told, there have been at least 29 fires at 23 refineries that use HF since the beginning of 2009. The most recent occurred on January 19 of this year, when a tube inside a furnace several hundred feet from

the HF alkylation unit at the Tesoro refinery in Mandan, North Dakota, failed, starting a fire that burned for more than two hours.

The company, in a statement to the Center, said its reaction to the fire demonstrated "the efficacy of Tesoro's emergency response safeguards and safety protocols." The company said "state-of-the-art water deluge cannons were engaged and any hydrofluoric acid being used at the facility was promptly transferred via underground pipeline to offsite isolation tanks. . . [A]t no time was there a release of HF or impact on the surrounding community."

Still, industry and government experts say that such incidents can indicate bigger vulnerabilities. "Sometimes seemingly minor events may be precursors for major accidents," a panel investigating the BP-Texas City explosion noted in 2007.

'I thought I was going to die'

At least three refineries that used HF were pressured by local officials and activists to alter their processes. Two years after a 1987 fire at Mobil's Torrance, Calif., refinery led to the release of about 100 pounds of HF, the city sued Mobil, asking a judge to declare the refinery a public nuisance. Mobil (now ExxonMobil) settled in 1990, agreeing to switch to a safer alternative by the end of 1994. With the city's blessing, the company chose a modified form of HF, which contains an additive that reduces the acid's tendency to form a cloud when discharged.

"They knew that the community wasn't happy with them," said R. Scott Adams, who was head of the city's fire department at the time. "They knew that they had to do something."

Another Los Angeles-area refinery wasn't ready to follow suit. Despite prodding from the South Coast Air Quality Management District, which regulates air pollution in Southern California, Ultramar insisted it could safely use HF at its refinery in Wilmington, Calif., recalled Mohsen Nazemi, the agency's executive officer for engineering and compliance.

The district disagreed and threatened to impose new rules on Ultramar, the only facility in the area still using HF, unless the company volunteered to make a change. "We sat down with them and said, 'This is basically a one-facility rule. We can work something out through a memorandum of understanding, or we can go forward and make this rule,'" Nazemi said. Faced with this choice, Ultramar agreed in 2003 to switch to modified HF by the end of 2005.

The company — later acquired by Valero — missed the deadline, racking up more than $1 million in penalties by the time the switch was made in January 2008.

Activists in Philadelphia, after obtaining the worst-case scenario for the Sunoco refinery -- on the southern edge of downtown only two miles or so from the city's professional football and baseball stadiums — took a different approach six years ago. Bob Wendelgass, then director of the Pennsylvania office of Clean Water Action, an environmental group, headed a grassroots campaign to convince Sunoco to transition to modified HF.

There was no litigation or regulatory action; instead, representatives of Clean Water Action, unions and other organizations knocked on doors, circulated petitions and sent letters to the editor.

"The publicity was starting to get embarrassing [for Sunoco]," Wendelgass said. "It's a scary chemical; that's the bottom line. We would talk to people about potential health effects. We would talk to people about areas at risk. And people's eyes would open wide as we went through it. Given that there's an alternative that's not that expensive for Sunoco, does it make sense for them to continue to put the community at risk?"

Sunoco completed its $125 million switch to modified HF in early 2010. But the move came too late for James Jamison, a contract ironworker who, with a dozen other workers, was caught in an HF release at the refinery on March 11, 2009.

Jamison, 36, told the Center he was welding about 30 feet off the ground in Unit 433, the HF alkylation unit. "I started to smell something out of the ordinary," he said. He stopped welding, saw no obvious source of the acidic odor and went back to work. The odor got stronger. "As soon as I started to weld, it overpowered me," Jamison said. "It was like a dark rain cloud. I couldn't breathe. It was so intense and hot I thought I was going to die right then."

Jamison staggered down to ground level. He heard no alarm, he said. He made it outside the unit, and a foreman drove him to a first-aid area. "Physically, I was out of it," he said. "The burning was still in my chest and throat and nose. It was like a heat wave from my nose to my stomach."

Jamison, who spent several weeks in the hospital, said he still feels the effects of the HF exposure. A former runner and weightlifter, he is unable to perform physical labor, exercise or play with his three children.

"It looks as though he has permanent damage to his heart and lungs," said David Fine, one of Jamison's lawyers. "I don't think there have been a ton of people who've gone through what this man's gone through and survived. He was in phenomenal shape."

In a statement to the Center, Sunoco said that during the incident "a small amount of HF was released, but there was no offsite or community impact and no injuries. Out of an abundance of caution, we sent 13 contractors to the hospital. One worker was admitted for a pre-existing medical condition unrelated to the incident." A Sunoco spokesman declined to identify the worker. Jamison was the only one who stayed in the hospital.

Fine said his client had no pre-existing condition prior to the accident. Jamison and three other contract workers sued Sunoco on February 18.

Jamison is receiving workers' compensation benefits, suggesting his ailments are work-related, Fine said. A cardiologist hired by the comp insurer examined Jamison and determined that HF exposure caused his condition, according to Fine.

Although Sunoco now uses modified HF, the company's worst-case scenario filed with the EPA in September 2010 shows that even the alternative compound carries significant risks: a potential acid release of 279,501 pounds extending eight miles from the refinery and threatening 1.3 million people.

This scenario "assumes the highly unlikely failure of all active safety measures," the company said in its statement to the Center, adding, "We take process and personal safety very seriously."

After conducting four inspections at the refinery from February 2009 to July 2010, OSHA cited Sunoco for 17 alleged violations, 11 of which had to do with process safety management. Sixteen of the 17 violations were classified as serious, one as a repeat infraction. OSHA found, for example, that the piece of equipment responsible for the HF release in Unit 433 had "an established history of tube leaks dating back to 1973." Sunoco is contesting the citation.

Safer alternative

There are at least three producers of solid acid catalyst, and they say it is much safer than either HF or sulfuric acid and less likely to corrode refinery equipment. One producer, a consortium consisting of Albemarle, ABB Lummus Global and Neste Oil, showcased its catalyst at a small demonstration plant in Finland, beginning in 2002. Another, Exelus Inc., believes its product — commercially available for the past four years — is ready for use in a full-scale refinery.

James Nehlsen, a chemical engineer and process development manager at Exelus, said the company has received inquiries from about a dozen refiners inside and outside the U.S. American refiners are "content to run their HF units, but they want to know what else is available should the government decide to prohibit an HF alkylation unit," he said. "Everyone wants to be first to be second in line."

So far, Nehlsen said, no American company has framed its interest solely in terms of worker or community protection. "That's not how refineries approach these sorts of issues," he said. "It's strictly a business decision."

Solid acid catalyst was on some companies' radar as long ago as the late 1990s. Bozorg Ettehadieh, an independent environmental consultant, said the firm he worked for at the time, the chemical manufacturer Rhodia, concluded that the product was about 90 percent of the way toward commercial viability. But Rhodia didn't view the technology as a threat to its sulfuric acid business, he said, because it seemed unlikely that the company's clients — many of them large refiners — would make the switch.

Nibarger, of the United Steelworkers, which represents many Chevron workers, said the company reportedly has begun testing solid acid catalyst at its Salt Lake City refinery. Chevron, in a written statement to the Center, would say only that it "actively researches refining enhancements, including catalyst ... technologies. Our work at the Salt Lake City refinery is in the early testing phase; therefore, it is premature to say that it represents a definitive path forward in fuels processing." The union, worried about the potential for harm to its members, has urged BP to stop using HF at its Texas City refinery as a "show of good faith," Nibarger said.

In a statement, BP said it has no plans to change. The company said it is counting on "mitigation and leak-detection systems ... to protect site personnel and the surrounding community from an accidental release" of HF. (BP recently announced ambitions to sell the refinery by 2013.) Nibarger isn't surprised by the industry's intransigence. "They have something that works, something that's cheap," he said, referring to HF. "They're not interested in trying an alternative, even if it's safer. Somebody needs to jump out and be the first."

Matthew Mosk and Brian Ross of ABC News contributed to this story. Laurel Adams, Amy Biegelsen, and Jeremy Borden of the Center for Public Integrity also contributed. A version of this story will appear on ABC's Nightline news program Feb. 24.